Parametric study of perturbations in the cross-flow boundary layer

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Session M25: Turbulence: Curvature and Flow Instability

8:00 AM–10:10 AM, Tuesday, November 25, 2014
Room: 2005

Chair: Leonardo Chamorro, University of Illinois at Urbana-Champaign

Abstract: M25.00001 : Parametric study of the perturbation dynamics in cross-flow boundary layer

8:00 AM–8:13 AM

Preview Abstract

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A parametric study on the life of small perturbations acting on a three-dimensional boundary layer in cross flow is discussed. Five parameters are considered: - Reynolds number, - angle of cross flow, - external pressure gradient, - wavelength and - waveangle. We use almost optimal initial conditions and solve an initial value problem to obtain information on the initial transient and temporal long-term behavior. A good agreement with other studies is observed (Breuer {\&} Kuraishi 1994,~ Corbett {\&} Bottaro 2001). Results concern the substantial role that asymptotically stable perturbations with a transient growth could have in triggering non-linear processes that lead to transition to turbulence. In fact for positive external pressure gradients~a subset of waves those have an intense transient growth show phase speeds directed~upstream. It is then possible that wave packets made with such waves propagate upstream~and contaminate the line of attack of the flow on the wing. We also computed the perturbed pressure field near the wall. In general, when a transient growth occurs, the perturbed pressure reaches its maximum value in significant advance in respect to the perturbed kinetic energy. But, for accelerated external flow and long wave perturbations, the opposite occurs.